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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Bueckers et al.

Serial No. To Be Assigned

Filed: Concurrently Herewith

For: **LONGITUDINALLY ACTIVATED COMPRESSION SEALING DEVICE FOR  
ELONGATE MEMBERS AND METHODS FOR USING THE SAME**

November 21, 2003

MAIL STOP PATENT APPLICATION

Commissioner for Patents

PO Box 1450

Alexandria, VA 22313-1450

SUBMITTAL OF PRIORITY DOCUMENTS

Sir:

To complete the requirements of 35 USC 119, enclosed are certified copies of the following

Great Britain priority applications:

0227985.9, filed November 30, 2002 and 0323267.5 filed October 4, 2003.

Respectfully submitted,



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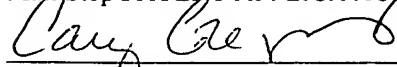
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1.	Your Reference	P51259C GB	0205002 5767454-1 002013 P01/7700 0.00-0227985.9	
2.	Patent Application number (The Patent Office will fill in this part)	0227985.9	30 NOV 2002	
3.	Full name, address and postcode of the or each applicant (underline all surnames)	Tyco Electronics Raychem NV Diestsesteenweg 692 B-3010 Kessel-Lo Belgium		
	Patents ADP Number (if you know it)	7954407001		
	If the applicant is a corporate body, give the country/state of its incorporation	Belgium		
4.	Title of the invention	SEALING DEVICE		
5.	Name of your agent (if you have one)	Fry Heath & Spence LLP		
	"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	The Gables, Massetts Road Horley, Surrey, RH6 7DQ G.B.		
	Patents ADP Number (if you know it)	8459554001		
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and (if you know it) the or each application number.	Country	Priority application number (if you know it)	Date of filing (day / month / year)
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(See note (d))

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Description 9

Claim(s) 4

Abstract 1

Drawing(s) 4 *+4* *M*

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Priority documents Nil

Translations of priority documents Nil

Statement of inventorship and right to grant of a patent (*Patents form 7/77*) Nil

Request for preliminary examination and search (*Patents form 9/77*) One */*

Request for substantive examination (*Patents form 10/77*) Nil *pl*

Any other documents Nil  
(*please specify*)

11. I/We request the grant of a patent on the basis of this application.

Signature

Date

*Anthony Clayton-Hathway*

29 November 2002

12. Name and daytime telephone number of person to contact in the United Kingdom Anthony Clayton-Hathway 01865 841060

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SEALING DEVICE

The present invention relates to a sealing device for sealing an opening in an object between the object and at least one elongate article extending through the opening. The invention has particular utility for sealing the end of a duct through which one or more cables, pipes or smaller ducts (often formed "micro-ducts") extend. However, the invention has broader applicability, and may, for example, be used to seal an opening in a splice case in which splices between telecommunications or power cables are enclosed.

Seals for sealing around one or more pipes or cables (or other elongate articles) to block off an opening in an object through which they extend are, of course, well known. Such seals often employ the use of a pair of compression plates and a deformable sealing material between the plates that is deformed into sealing contact with the object and with the elongate articles. For example, United States Patent No. 4,267,401 (Wilkinson), UK Patent Application GB 2 262 392 A (Jack Moon) and International Patent Application WO 97/42693 disclose seals of this type.

The present invention seeks to provide an improved seal that is easier to assemble than the known seals, and that can provide greater sealing reliability.

Accordingly, a first aspect of the invention provides a sealing device for sealing an opening in an object between the object and at least one elongate article extending through the opening, comprising a pair of compression plates, at least two deformable sealing elements spaced apart from each other between the plates, and a compression device arranged to compress the sealing elements by moving the plates towards each other thereby expanding the sealing elements in a lateral direction with respect to the direction of movement of the plates such that each sealing element

makes a respective sealing contact with the object or a said elongate article.

A second aspect of the invention provides a kit of parts for forming a sealing device according to the first aspect of the invention, comprising the pair of compression plates, the at least two deformable sealing elements, and the compression device.

The invention has the advantage that because the sealing device comprises sealing elements spaced apart from each other between the compression plates (in order to provide their respective sealing contacts) it avoids the need to compress a mass of sealing material extending throughout the entire area between the plates (which is the case with the seals disclosed in the above documents). This has the great benefit that the compression force required to deform the seals and make the sealing contacts is reduced (for a given sealing material). Consequently, it is easier for the installation engineer to form the seal, and most importantly, for the seal to be formed without damaging the micro-ducts or other elongate articles. Also, it means that the seal may be more reliable because it may be less prone to failure over time due to the use of a lower compression force (in addition to the enhanced reliability due to the seal being easier to form in the first place). Additionally, the use of a lower compression force means that the strength and robustness of the various components of the sealing device is generally less critical than hitherto (with the associated manufacturing advantages).

In preferred embodiments of the invention, the sealing device includes a first sealing element located between the compression plates along the lateral periphery of the plates, thereby to make a sealing contact with the object.

Preferably each compression plate includes at least one aperture, the apertures of the plates being in alignment and together providing a channel



through the sealing device to allow an elongate article to extend through the device.

The sealing device preferably includes at least one second sealing element located between the plates around a channel, to make a sealing contact with an elongate article extending through the channel. Preferably the sealing device includes a plurality of such channels, each of which has a respective second sealing element located therearound.

Each sealing element preferably comprises a tube. Preferably the tube has a length at least as great as its external diameter. Alternatively, each sealing element may comprise an o-ring, for example. A plurality of o-rings (for example two) may be located next to each other to form a combined sealing element (and therefore in effect acting as a sealing tube). An advantage of a tube-shaped sealing element (or a plurality of o-rings combining to form a single sealing element) is that the sealing contact is greater than that of a single o-ring, for example. An advantage of a tube sealing element over a plurality of o-rings is that the tube is generally easier to handle and to install.

In particularly preferred embodiments of the invention, the sealing device comprises a support located between the compression plates, to which the sealing elements are attached. Preferably the sealing elements are integral with the support; the support and the sealing elements preferably are formed as a single piece. The support preferably comprises a sheet, but other forms of support may be used, for example it may comprise a framework or the like. For embodiments in which the support comprises a sheet, the sheet may be perforated, for example.

The support preferably is dimensioned such that it is not compressed when the sealing elements are compressed (to form their respective sealing contacts). In particular, the sealing elements and the support preferably have relative thicknesses in the dimension in which the compression plates

are moved towards each other by the compression member, such that when the sealing elements are compressed and form their respective sealing contacts, the support is not compressed.

In some preferred embodiments of the invention, each sealing element may be blocked by a removable blocking part that may be removed to allow an elongate article to extend through the sealing element. Advantageously, the blocking parts may be elongate and extend through at least one of the compression plates so that they may be removed without removing the sealing elements from between the plates. Additionally or alternatively, each aperture of at least one of the compression plates may be blocked by a removable blocking piece that may be removed to allow an elongate article to extend through the aperture.

The compression plates preferably are generally circular (i.e. generally disk-shaped). However other shapes are possible depending upon the shape of the opening in the object that needs sealing. Also, although they are described herein as "plates" it is to be understood that they need not (at least in the broadest aspects of the invention) be substantially in the form of plates; other shapes are possible, as long as they fulfil their purpose of compressing the sealing elements.

The compression device may generally be any device (including a plurality of discrete parts) suitable for moving the compression plates towards each other to compress the sealing elements. Preferably, however, the compression device comprises at least one screwthreaded device (e.g. a bolt or a screw fastener) arranged to form a screwthreaded engagement with the compression plates.

It is particularly preferred for the compression plates to be movable towards each other by means of the compression device such that when the plates are as close as possible to each other, the sealing elements undergo a preset lateral expansion. This has the advantage of ensuring that the

correct, preset sealing contacts may be made. Additionally or alternatively, the sealing device may include an indicator to indicate when the compression plates have been moved towards each other by a correct predetermined distance such that the preset lateral expansion of the sealing elements (and hence the preset sealing contact of each of the sealing elements) has been made. Advantageously, the indicator may comprise at least one indicator member arranged to extend from one of the compression plates through the other compression plate, or from the support through one of the compression plates, such that when the relative movement of the plates by the predetermined distance has been achieved, the indicator member extends through the compression plate.

The object in which the sealing device seals an opening may, for example, be a duct, a splice case, or the like. The elongate article or articles may, for example be micro-ducts, cables, pipes or the like. However, in some preferred embodiments of the invention, the object in which the sealing device seals an opening may itself comprise part of the device or kit. For example, the object may comprise a housing that is attachable to an end of a duct (or the like), the housing and the remainder of the sealing device together sealing the end of the duct.

The sealing elements (and preferably also the support for those embodiments of the invention including a support) preferably are formed from polymeric material. The preferred polymeric material is rubber, especially synthetic rubber, for example nitrile rubber, silicone rubber etc. The material may be in the form of a foam (preferably a closed cell foam).

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figure 1 is an exploded diagram of the main components of an embodiment of a sealing device kit according to the invention, together with a view of the assembled sealing device;

Figure 2 is a cross-sectional view of the assembled sealing device of Figure 1;

Figure 3 is a partially cut away perspective view of another embodiment of a sealing device according to the invention, installed on the open end of a duct carrying seven micro-ducts; and

Figure 4 is an exploded diagram of an embodiment of a sealing device similar to that illustrated in Figure 1, including indicator members to indicate when a predetermined compression of the sealing elements has been achieved.

Figure 1 shows a sealing device 1 comprising a pair of compression plates 3 and 5, each of which has a plurality of apertures 7 extending through the plate, through which elongate articles (not shown) may extend during use. Between the compression plates 3 and 5 is a support 9 in the form of a synthetic rubber flexible sheet. The support 9 has attached thereto (and in fact integrally moulded with the sheet) a plurality of second sealing elements 11a in the form of tubes which project from a major surface of the support. Because of the perspective of the drawing the second sealing elements 11a are not visible in Figure 1, but they are shown in cross-section in Figure 2.

Figure 1 does, however, show elongate removable blocking parts 13 projecting from the opposite major surface of the support 9 to that from which the sealing element tubes 11 project. Each blocking part 13 is associated with a respective second sealing element 11a and blocks the channel formed by the aligned apertures 7 and the second sealing element 11a in the assembled sealing device. As shown in the view of the assembled sealing device shown in Figure 1, the elongate blocking parts 13 project through the apertures 7 in the "front" compression plate 3, and they may be selectively removed as required by being torn away from the

support 9 to allow an elongate article, e.g. a micro-duct, to extend through the channel in the sealing device that the blocking part had originally blocked off.

Figure 1 also shows a compression device 15 in the form of a screwthreaded bolt that is arranged to extend through both compression plates 3 and 5 and the support 9, and to move the plates towards each other by means of a corresponding screwthread 17 in the "rear" compression plate 5. Also shown in Figure 1 is a housing 19 of the sealing device, in which the compression plates and the support are arranged to be installed, to seal an opening 21 in the housing. The entire sealing device, including the housing 19, is arranged to be installed on the open end of a duct (for example) in the manner illustrated in Figure 3, in order to seal the end of the duct. The compression plates and support are secured in the housing 19 by means of screw fasteners 23.

Figure 2 shows the assembled sealing device 1 of Figure 1 in cross-section. Two of the tube shaped second sealing elements 11a are shown in this view. Each second sealing element 11a is arranged to seal a respective channel 25 extending through both compression plates 3, 5, and the support 9 when an elongate article, for example a micro-duct 27 as shown in Figure 3, extends through the channel (the respective blocking part 13 having been removed beforehand). Movement of the compression plates 3, 5 towards each other by the screwthreaded compression device 15 as indicated by arrows A causes each second sealing element 11a to be expanded laterally as indicated by arrows B into sealing contact with a respective elongate article (not shown) extending through the sealing device. This movement of the compression plates 3, 5 towards each other also compresses another sealing element, namely first sealing element 11b that is arranged along the periphery of the compression plates (between the plates). The first sealing element 11b consequently is expanded laterally outwards as indicated by arrows C into sealing contact with the housing 19. First sealing element 11b is also in the form of a tube projecting from a

major surface of the support 9 (similarly to the second sealing elements 11a), however the diameter of the tube of first sealing element 11b is, of course, considerably larger than that of second sealing elements 11a.

As illustrated clearly in Figure 2, each of the sealing elements 11a and 11b are spaced apart from each other between the compression plates. Also as clearly shown in Figure 2, the relative thicknesses (in the direction of movement of the plates as indicated by arrows A) of the sealing elements and the support 9 are such that when the sealing elements are compressed between the plates, the support itself is not compressed, i.e. there is a gap 29 between the support and at least one of the compression plates when the sealing elements are compressed. This has the tremendous advantage that because only the discrete sealing elements are compressed (and not an entire mass of sealing material extending throughout the entire area between the compression plates), lower compression forces (than would otherwise have been the case) are required. This provides the benefits described earlier, such as lessening the risk of damage to micro-ducts or other elongate articles extending through the sealing device. However, not only does the embodiment of the invention shown in Figures 1 and 2 have this particular advantage, but it also has the advantage of ease of assembly and handling because all of the sealing elements are carried on a single support.

The entire sealing device 1 may be attached to the end of a duct (or the like), preferably on an outside surface of the duct, via the housing 19 in order to seal the end of the duct. Preferably there are additional seals (for example tubular seals or o-ring seals) between the housing 19 and the duct. Such seals preferably are retained in grooves 31 provided in the housing. The housing may be secured to the duct in any suitable manner, for example by a tightened securement band 33 around the housing as shown in Figure 3.

Figure 3 shows an alternative embodiment of sealing device 1 according to the invention secured to the open end of a duct 35. The duct 35 carries a plurality (seven as shown) of micro-ducts 27. The micro-ducts 27 themselves carry optical fibres, wires, cables or the like. The Figure 3 embodiment of the sealing device does not include a support; instead the sealing elements 11a and 11b are o-rings. It can be seen that the sealing elements 11a each comprise a pair of o-rings, for increased sealing capability. The o-rings are retained in recesses in one (or both) of the compression plates.

It can be seen in both Figure 3 and Figure 2 that the screwthreaded compression device 15 may be tightened only to a preset extent such that the compression plates are moved towards each other by a preset distance. Preferably this is arranged such that the preset tightening of the compression device causes a preset lateral expansion of the sealing elements, thereby providing a preset sealing contact force between the sealing elements and their respective elongate article or object.

Figure 4 is an exploded diagram of an embodiment of a sealing device similar to that illustrated in Figure 1. However, in this embodiment the support 9 includes indicator members 39 arranged to extend through holes 41 in the front compression plate to indicate when the compression plates 3 and 5 have been moved towards each other by a predetermined distance such that a predetermined compression of the sealing elements has been achieved.

Claims

1. A sealing device for sealing an opening in an object between the object and at least one elongate article extending through the opening, comprising a pair of compression plates, at least two deformable sealing elements spaced apart from each other between the plates, and a compression device arranged to compress the sealing elements by moving the plates towards each other thereby expanding the sealing elements in a lateral direction with respect to the direction of movement of the plates such that each sealing element makes a respective sealing contact with the object or a said elongate article.
2. A kit of parts for forming a sealing device according to claim 1, comprising a said pair of compression plates, at least two said deformable sealing elements, and a said compression device.
3. A sealing device or kit according to claim 1 or claim 2, comprising a first sealing element located between the compression plates along a lateral periphery of the plates, thereby to make a sealing contact with the object.
4. A sealing device or kit according to any preceding claim, in which each compression plate includes at least one aperture, the apertures of the plates being in alignment and together providing a channel through the sealing device to allow a said elongate article to extend through the device.
5. A sealing device or kit according to claim 4, comprising at least one second sealing element located between the plates around a said channel, to make a sealing contact with a said elongate article extending through the channel.



6. A sealing device or kit according to claim 5, comprising a plurality of said channels, each of which has a respective second sealing element located therearound.
7. A sealing device or kit according to any preceding claim, in which at least one of the sealing elements comprises a tube.
8. A sealing device or kit according to claim 7, in which the tube has a length at least as great as its external diameter.
9. A sealing device or kit according to any preceding claim, in which at least one of the sealing elements comprises at least one o-ring.
10. A sealing device or kit according to claim 9, in which at least one of the sealing elements comprises a plurality of o-rings.
11. A sealing device or kit according to any preceding claim, comprising a support located between the compression plates, to which the sealing elements are attached.
12. A sealing device or kit according to claim 11, in which the support and the sealing elements are formed as a single piece.
13. A sealing device or kit according to claim 11 or claim 12, in which the support comprises a sheet or a framework.
14. A sealing device or kit according to any one of claims 11 to 13, in which the support is not compressed when the sealing elements are compressed by the compression plates.
15. A sealing device or kit according to claim 14, in which the sealing elements and the support have relative thicknesses in the direction of

movement of the compression plates such that the support is not compressed when the sealing elements are compressed by the plates.

16. A sealing device or kit according to any preceding claim, in which each sealing element is blocked by a removable blocking part that may be removed to allow a said elongate article to extend through the sealing element.
17. A sealing device or kit according to claim 16, in which each blocking part is elongate and extends through at least one of the compression plates so that it may be removed from its respective sealing element without removing the sealing element from between the plates.
18. A sealing device or kit according to any preceding claim, in which each aperture of at least one of the compression plates may be blocked by a removable blocking piece that may be removed to allow an elongate article to extend through the aperture.
19. A sealing device or kit according to any preceding claim, in which the compression plates are movable towards each other by means of the compression device such that when the plates are as close as possible to each other the sealing elements are laterally expanded by a preset amount.
20. A sealing device or kit according to any preceding claim, in which the sealing device includes an indicator to indicate when the compression plates have been moved towards each other by a correct predetermined distance such that a preset lateral expansion of the sealing elements has been made.
21. A sealing device or kit according to claim 20 when dependent upon claim 11, in which the indicator comprises at least one indicator member arranged to extend from one of the compression plates

through the other compression plate, or from the support through one of the compression plates, such that when the relative movement of the plates by the predetermined distance has been achieved, the indicator member extends through the compression plate.

22. A sealing device or kit according to any preceding claim, further comprising the object, the object comprising a housing that is attachable to the end of a duct to seal the duct in combination with the remainder of the sealing device.
23. A sealing device or kit according to any preceding claim, in which the sealing elements are formed from polymeric material.



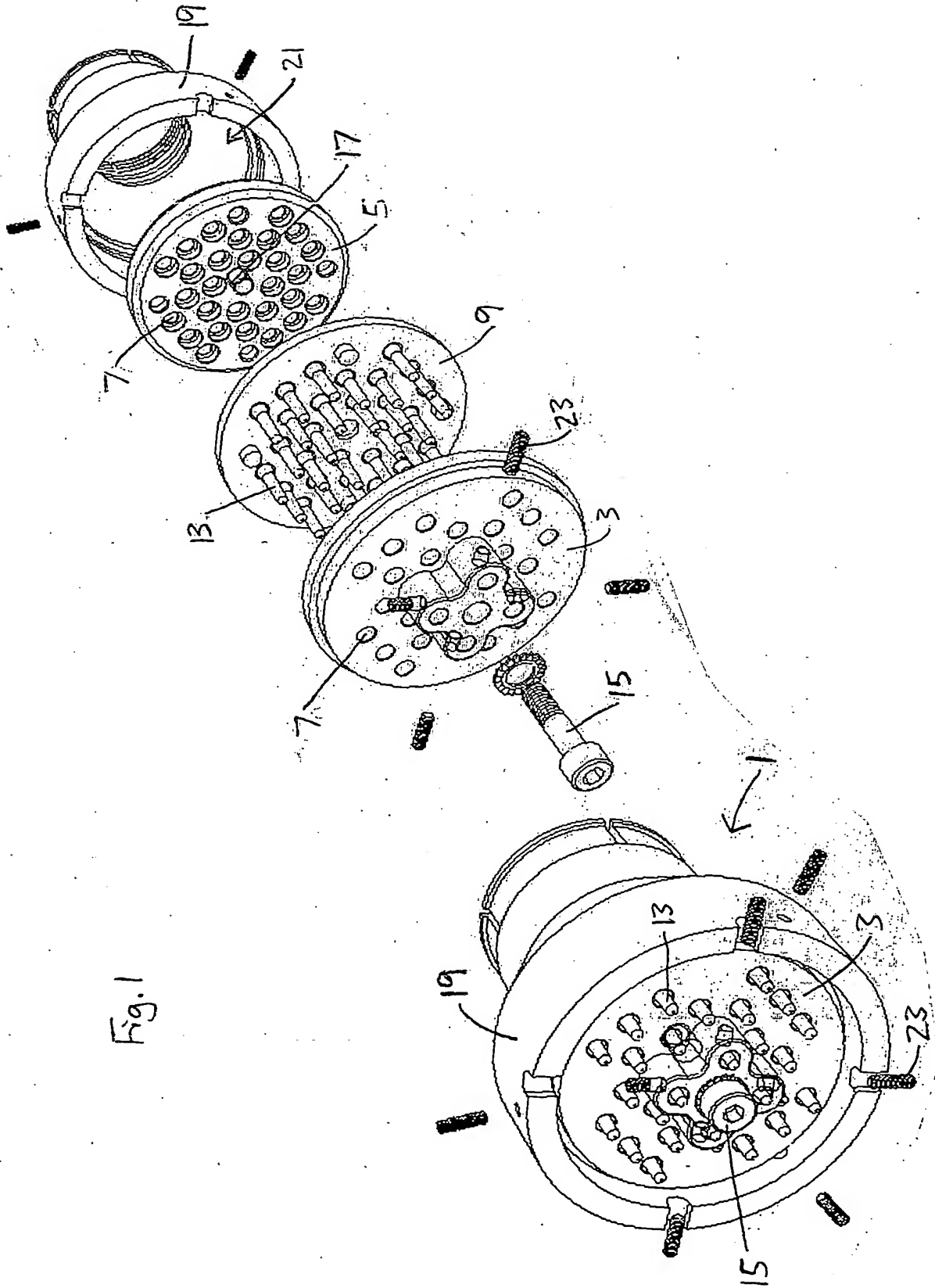
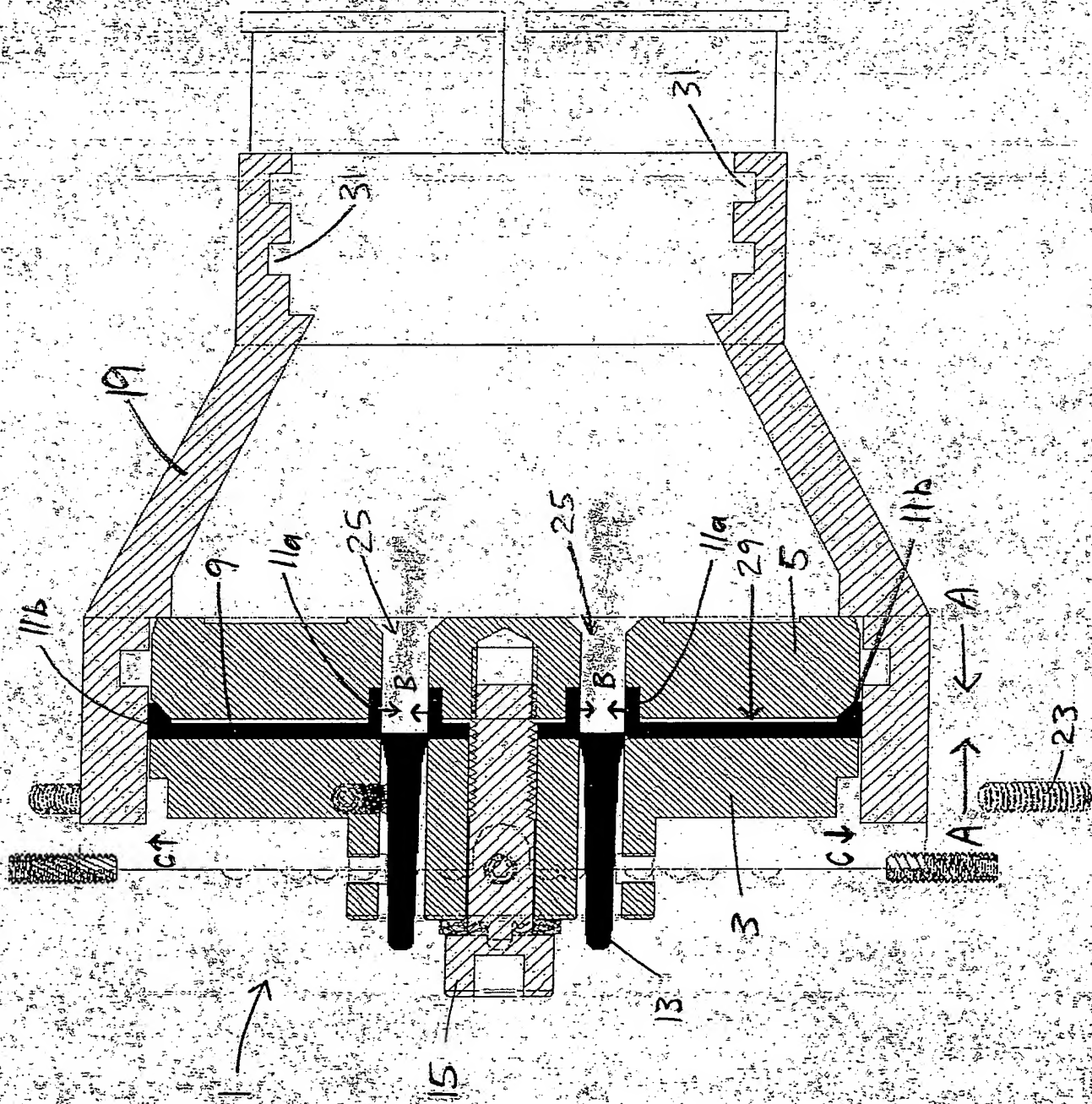


Fig. 1





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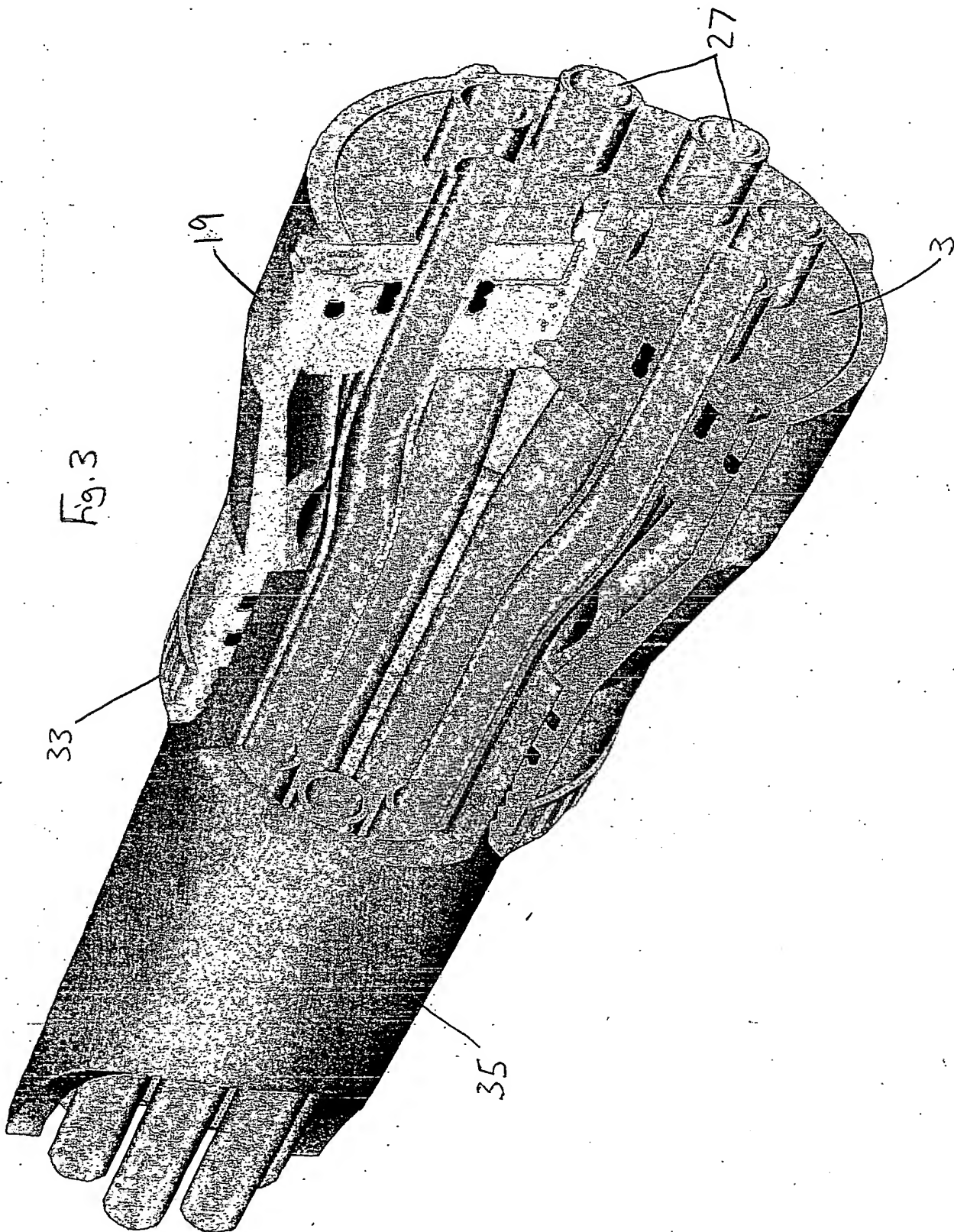
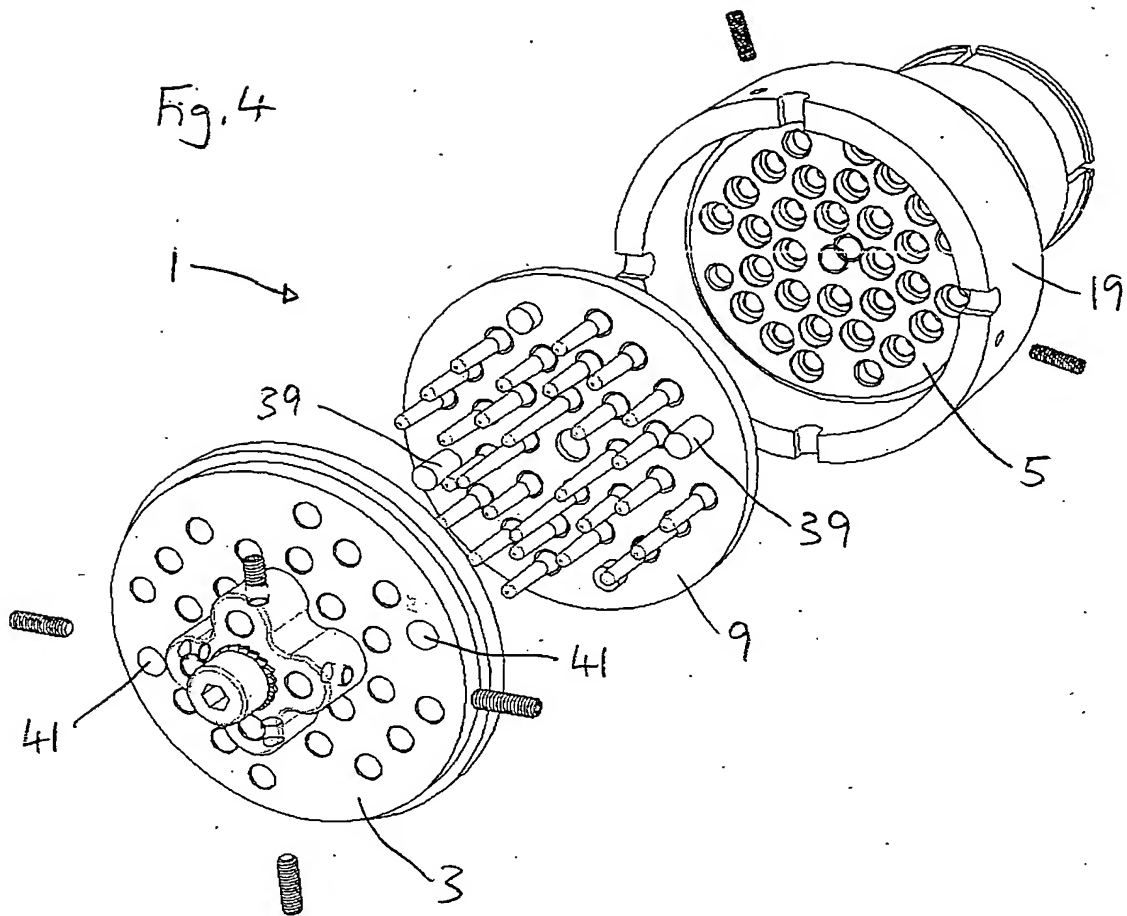




Fig. 4



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